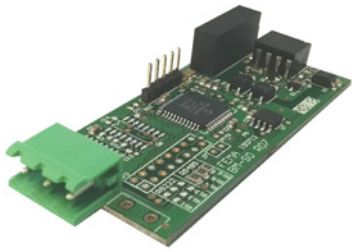
FEMA ELECTRÓNICA

User's Manual

ELECTRONICS FOR INDUSTRIAL AUTOMATION
PANEL METERS . SIGNAL CONVERTERS . LARGE DISPLAYS



Series M . Module S4

RS-485 serial ASCII communication

PANEL METERS . OPTIONAL CONTROL MODULES

RS-485 communications module, for M Series panel meters. Data retransmission in ASCII protocol on RS-485 bus. 'Master' / 'Slave' architecture, up to 31 addresses. Access to the instrument registers : reading value, alarm status, maximum and minimum memory values, alarm setpoints, ... Up to 57600 bps. Isolated module.

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3499r02

1. S4 module

RS-485 communications module with ASCII protocol

RS-485 communications module for M Series of panel meters, with access to the instrument registers. ASCII protocol with 'Master' / 'Slave' architecture. Addressable with up to 31 modules. Frames codified in representable ASCII characters (codes 32 to 255), directly visible using 'hyperterminal' or similar programs.

Configuration from instrument front keypad, through menu entries 'Opt.1', 'Opt.2' or 'Opt.3', depending on the position the module is installed *(see section 1.15)*.

• Configurable for direct retransmission to remote meter of M Series (14 mm and 20 mm digit height) and BDF Series (60 mm and 100 mm digit height).

• Access to display values, alarm status, memory of maximum and minimum, alarm setpoints, ...

The S4 module can be ordered pre-installed into a M Series panel meter, or standalone for delayed installation, as it does not require soldering or special configuration.

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1.1 How to order

To order **pre-installed** S4 modules into M Series panel meters, see the 'How to order' section into the panel meter user's manual, for information on how to build the order reference.

To order **standalone** S4 modules, for **delayed** installation into M Series panel meters, use the following ordering reference : 'BM-S4'

1.2 How to install the S4 module

To install a S4 module into a M Series panel meter :

1. open the instrument housing *(see section 1.14)*

2. install the module in the preferred slot 'Opt.1', 'Opt.2' or 'Opt.3', and close the instrument.

3. configure the module as indicated in the 'Configuration menu' *(see section 1.6)*

4. connect the signal terminals *(see section 1.4)*

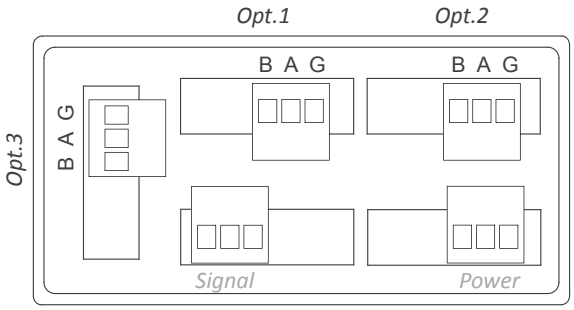
1.3 Technical specifications

Slots allowed	'Opt.1', 'Opt.2', 'Opt.3' *(see section 1.15)*
Bus	RS-485
speed	57.6 Kbps to 600 bps
data format	8n1 (standard), 8o1, 8n2, 8e1
Protocol	ASCII
architecture	'Master' / 'Slave'
addresses	01 to 31
broadcast address	128
registers*	see section *1.7*

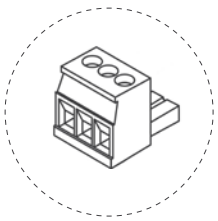
**available registers can vary for different models (see section 1.13)*

Isolation	1000 Vdc
Configuration	3 button front keypad
Temperature	operation from 0 to 50 ºC
	storage from -20 to +70 ºC

1.4 Rear view and connections



Terminal B	*RS485 bus 'B' signal*
Terminal A	*RS485 bus 'A' signal*
Terminal G	*GND*

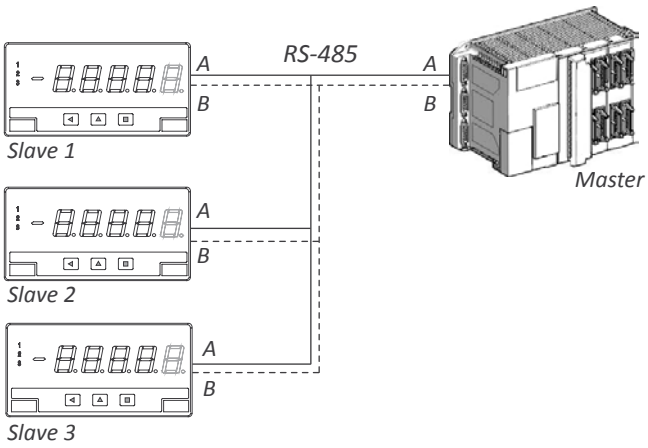


Detail of the plug-in screw terminals provided with the instrument. The instrument is provided with all terminals needed, both male and female.

1.5 'Master' and 'Slave' modes

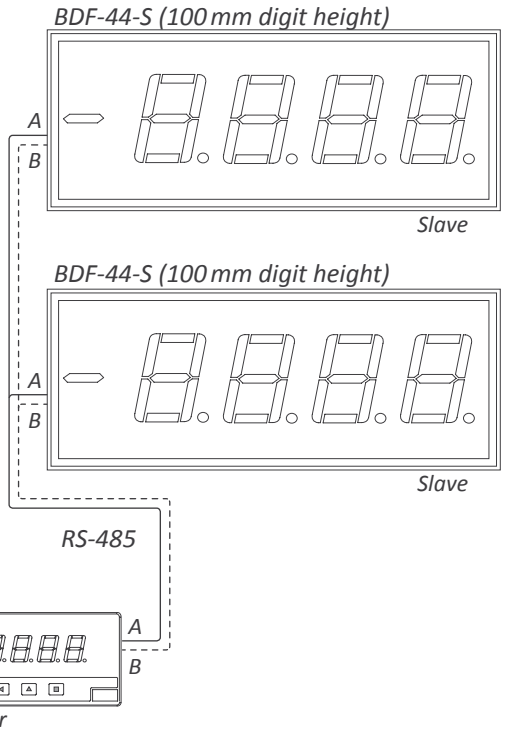
The S4 module can be configured to operate as 'Master' or as 'Slave'.

• In 'Slave' mode the module remains still waiting to receive data request frames from the 'Master'. The 'Master' can be a PLC, a SCADA system, etc.



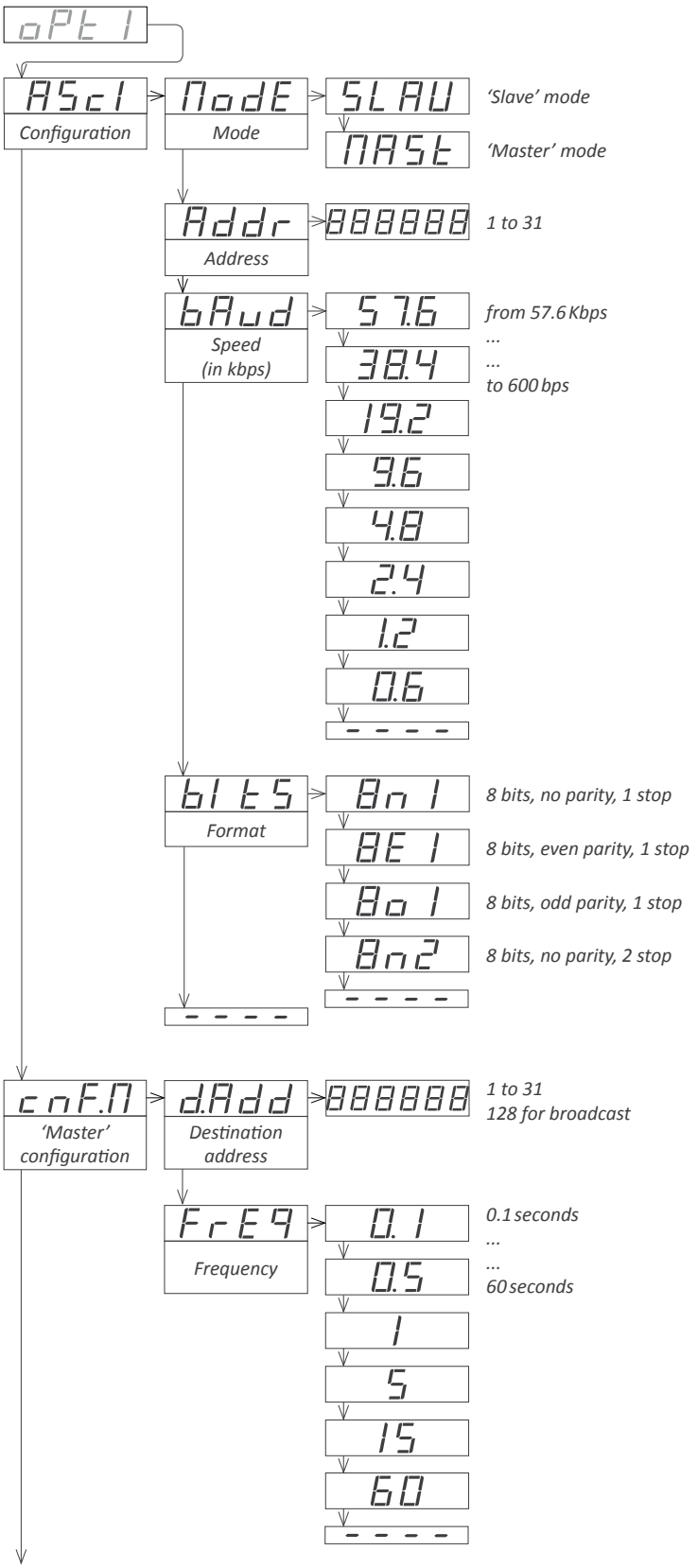
• In 'Master' mode, the module is configured to continuously transmit data frames, at a configured rate. The frames transmitted contain the reading value of the instrument. This frames can be remotely received and the value displayed with M Series and BDF Series panel meters.

** Note - to use the 'Master' mode together with the BDF large format displays (60 mm and 100 mm digit height) the parameter 'Legacy mode' ('LEG') must be set to 'on', inside the 'Tools' ('tooL') menu section (see section 1.6.3).*



1.6 Configuration menu

To access the '*configuration menu*' of the module, press the [■] key for 1 second, and then move through the menu with the [▲] key until the 'Opt.X' entry, corresponding to the slot were the module is installed *(see section 1.15)* is displayed. Press the [■] key to access the module configuration menu. See the 'How to operate the menus' section in the instrument user's manual for a detailed description on how to move through the menus.



1.6.1 Initial set-up

To configure the module, assign the working mode, the module address, the bus speed and data format. These parameters are configured at the '**Configuration**' ('**ASCI**') menu.

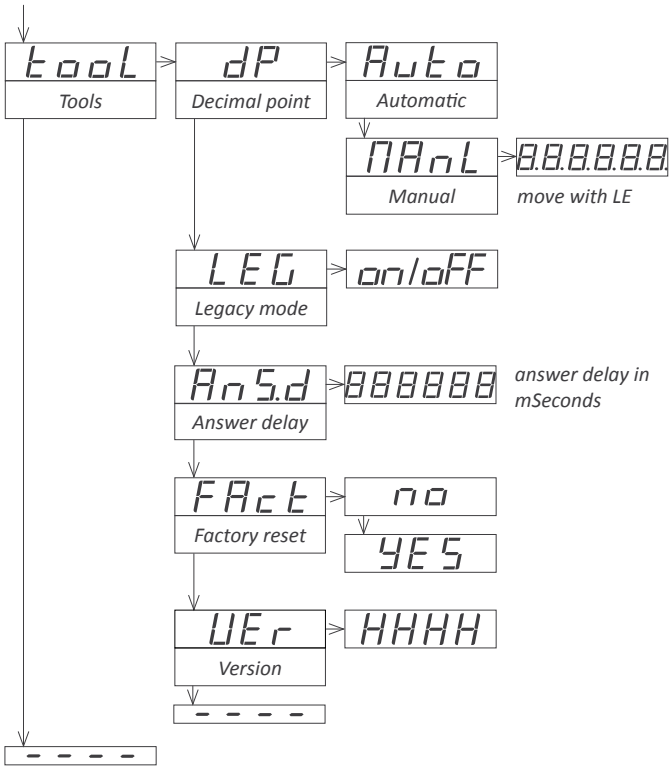
- access the '**ModE**' ('**ModE**') menu to select the working mode as '**Master**' ('**MASt**') or '**Slave**' ('**SLAV**') *(see section 1.5)*.
- assign the module address into the '**Address**' ('**Addr**') parameter by selecting a value between '1' and '31'. In 'Master' mode this address is always '0' independent of the value entered.
- at the '**Speed**' ('**bAud**') parameter, select the bus speed (in kbps).
- at the '**Format**' ('**bItS**') parameter, select the data format. The default format is '**8n1**'.

1.6.2 'Master' mode configuration

The 'Master' mode allows for continuous retransmission of the display values through the communications bus. The module address is always fixed to '0' and parameters to configure are the destination address and the frequency of message retransmission. the 'Master' mode configuration is located at the **''Master' configuration**' ('**cnF.M**') menu *(see section 1.5)*.

- at the '**Destination address**' ('**d.Add**') parameter, enter the address of the remote destination instrument. Data frames will be directed to this address. Available values are '1' to '31' for a single remote destination instrument, or '128' for a broadcast transmission.
- at the '**Frequency**' ('**FrEq**') parameter select the time (in seconds) between data frames.

1.6 Configuration menu (cont.)



1.6.3 Menu 'Tools'

Several special tools are grouped inside the '**Tools**' ('**TooL**') menu.

• the '**Decimal point**' ('**dP**') menu is provided for compatibility with previous hardwares that do not support decimal point retransmission. By default, select '**Automatic**' ('**Auto**'). If your instrument does nos transmit the decimal point position, select '**Manual**' ('**MAnL**') and fix the position of the decimal point manually.

•the '**Legacy mode**' ('**LEG'**) parameter is provided to maintain compatibility with instruments with older communication protocols. Select '**on**' to activate this mode.

• the '**Answer delay**' ('**AnS.d'**) parameter applies only to 'Slave' mode modules. It allows to delay the answer frame in those applications where the 'Master' needs additional time to switch between 'transmit' and 'receive' modes. Enter a numeric value between '0' and '1000' mSeconds.

• at the '**Factory reset**' ('**FAct**') menu, select '**yes**' to load the default factory configuration for the instrument *(see section 1.17).*

• the '**Version**' ('**VEr**') menu informs of the current firmware version installed in the module.

1.7 Registers

The table below lists all the available registers. For a list of registers available for each instrument, see section *1.13*. Display values (DISPLAY1, MAXMEM, MINMEM, AL1, AL2, AL3) are codified with a minimum of 6 digits (left zeros are added if necessary), polarity and decimal point.

Register	*Name*	*Description*
0	*DISPLAY1*	*Display1 value*
1	*MAXMEM*	*Memory of maximum*
2	*MINMEM*	*Memory of minimum*
3	*AL1*	*Setpoint1 value*
4	*AL2*	*Setpoint2 value*
5	*AL3*	*Setpoint3 value*
6	*STATUS*	*Alarm status*

Table 1 - Accessible registers for ASCII protocol. Available registers can vary for different models (see section 1.13)

Register 0 - DISPLAY1

Contains the display value of the instrument, in ASCII code, including polarity (positive / negative) and decimal point.

Example1 *R0='+' '0' '6' '5' '4' '3' '.' '2'*
Display value = 6543.2

Example2 *R0='-' '0' '0' '0' '4' '.' '5' '2'*
Display value = -4.52

Register 1 - MAXMEM

Contains the value for memory of maximum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 2 - MINMEM

Contains the value for memory of minimum, in ASCII code, including polarity (positive / negative) and decimal point.

Register 3 - AL1

Contains the value for alarm 1 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 4 - AL2

Contains the value for alarm 2 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 5 - AL3

Contains the value for alarm 3 setpoint, in ASCII code, including polarity (positive / negative) and decimal point.

Register 6 - STATUS

Contains the alarm status (on/off). See the table below.

Bit	*Description*
0	*Status of alarm 1 (0 = inactive, 1 = active)*
1	*Status of alarm 2 (0 = inactive, 1 = active)*
2	*Status of alarm 3 (0 = inactive, 1 = active)*
3...15	*Reserved*

Table 2 - Description for register 6

1.8 Types of frames

The implemented ASCII protocol defines the following types of frames:

• Frame 'read' ('**RD**'). Id code 36. Frame to request data to a remote instrument. The requested register is indicated into the 'REG' byte ('Header' section).

• Frame 'answer' ('**ANS**'). Id code 37. Response frame to a correct 'read' frame. The requested register is indicated in the 'REG' byte ('Header' section) and the data of the requested register is indicated into data bytes 'D0' to 'Dn' ('Data' section).

• Frame 'error' ('**ERR**'). Id code 38. Response frame to an incorrect 'read' frame. The 'error' frame indicates that an error has occurred. Error code is codified into the 'REG' byte ('Header' section). For a list of error codes, see section *1.12.*

• Frame 'ping' ('**PING**'). Id code 32. The 'ping' frame provides a fast 'keep alive' frame to confirm the existence of the remote instrument. Remote instrument will always reply with a 'pong' frame.

• Frame 'pong' ('**PONG**'). Id code 33. Response to a 'ping' frame. It confirms the existence of the remote instrument.

1.9 Frame structure

Header								Data				Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	...	Dn	CRC	ETX
2	x	32	x	x	x	32	n+1	[data]				x	3
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*...*	*n+7*	*n+8*	*n+9*

The implemented frames have a structure made of 'Header', 'Data' and 'Trail'.

Section 'Header'

Contains the start of frame byte ('STX'), the frame identifier ('ID'), the origin address ('FROM') and the destination address ('TO'), the register identification ('REG') and the length ('LONG') of the 'Data' section.

Section'Data'

Contains data ('D0' to 'Dn') for the requested register ('REG').

Section 'Trail'

Contains the 'CRC' code and the end of frame byte ('ETX').

'Real value' and 'Frame value'

To use representable ASCII values, the real values are codified before being sent into the frame. The following definitions apply :

- 'real value' is the value of the field without codification
- 'frame value' is the value of the field, codified

Field	*Description*	*Size*	*Position*	*Real value*	*Frame value*
STX	*Start of frame*	*1 byte*	*0*	*does not apply*	*2*
ID	*Frame type*	*1 byte*	*1*	*(see section 1.8)*	*real_value*
RSV	*Reserved*	*1 byte*	*2*	*0*	*32*
FROM	*Origin address*	*1 byte*	*3*	*0 ('Master') / 1 a 31 ('Slave')*	*32 + real_value*
TO	*Destination address*	*1 byte*	*4*	*0 ('Master') / 1 a 31 ('Slave')* *128 ('Broadcast')*	*32 + real_value*
REG	*Register identification*	*1 byte*	*5*	*(see section 1.7)*	*32 + real_value*
RSV	*Reserved*	*1 byte*	*6*	*0*	*32*
LONG	*Length of 'Data' section*	*1 byte*	*7*	*n (between 0 and 32)*	*32 + real_value*
D0 ... Dn	*Data*	*n bytes*	*8 a n+7*	*number 0 to 9* *decimal point* *polarity (+/-)*	*ASCII code of the number (48 to 57)* *ASCII code of decimal point (46)* *ASCII code of '+' (43)* *ASCII code of '-' (45)*
CRC	*CRC calculation*	*1 byte*	*n+8*	*does not apply*	*(see section 1.11)*
ETX	*End of frame*	*1 byte*	*n+9*	*does not apply*	*3*

Table 3 - ASCII frame byte descriptions

1.10 Frame examples

1.10.1 Frames ‘RD’ (36) and ‘ANS’ (37)

Example - ‘Master’ (address ‘0’) requests the value of register ‘0’ (display value) to the ‘Slave’ at address ‘28’ (‘RD’ frame) and the ‘Slave’ replies to the ‘Master’ with a reply frame (‘ANS’ frame) containing the requested data (765.43).

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	36	32	32	60	32	32	32	58	3
Start	RD	---	0	28	0	---	0	CRC	Stop

Header								Data								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	D0	D1	D2	D3	D4	D5	D6	D7	CRC	ETX
2	37	32	60	32	32	32	40	43	48	55	54	53	46	52	51	15	3
Start	ANS	---	28	0	0	---	8	+0765.43								CRC	Stop

1.10.2 Frame ‘ERR’ (38)

Example - ‘Slave’ at address ‘11’ replies to the ‘Master’ (address ‘0’) with an error frame (‘ERR’ frame) indicating that the requested register number is unknown (‘UNKNOWN_REGISTER’, error code ‘1’). The error code is codified into the ‘REG’ byte. For a list of error codes see section 1.12.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	38	32	43	32	33	32	32	46	3
Start	ERR	---	11	0	1	---	0	CRC	Stop

1.10.3 Frames ‘PING’ (32) and ‘PONG’ (33)

Example - ‘Master’ (address ‘0’) requests confirmation of existence to the ‘Slave’ at addrress ‘22’ (‘PING’ frame) and the ‘Slave’ replies to the ‘Master’ with a ‘PONG’ frame.

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	32	32	32	54	32	32	32	52	3
Start	Ping	---	0	22	0	---	0	CRC	Stop

Header								Trail	
STX	ID	RSV	FROM	TO	REG	RSV	LONG	CRC	ETX
2	33	32	54	32	32	32	32	53	3
Start	Pong	---	22	0	0	---	0	CRC	Stop

1.11 CRC calculation

The 'frame value' for the CRC byte is calculated applying a XOR function to the 'frame value' *(see section 1.9)* of all bytes in sections 'Header' and 'Data', from byte '0' ('STX') to the last data byte ('Dn').

• if the calculated CRC value is lower than '32', it is normalized by applying the 'one's complement' function .

CRC0=STX ^ ID ^ RSV ^ FROM ^ TO ^ REG ^ RSV ^ LONG ^ D0 ^...^ Dn

• if (CRC0<32) -> CRC=!CRC0 (one's complement function)

• if (CRC0>31) -> CRC=CRC0

```
//example of CRC calculation in C language
int8 Calculate_CRC(int8 CRC_Position)
{
 int8 i,CRC=0;
  for(i=0;c<CRC_Position;c++)
  {
     crc=crc ^ frame[i];
  }
 if(crc<32) CRC=~CRC;
 return(CRC);
}
```

1.12 Error codes

The frame error codes are informed within the 'REG' field of the 'ERR' frames *(see section 1.10.2)*. Available error codes are listed in the table below :

Error	*Description*
1	*Unknown register*
2	*Display in Overrange*
3	*Display in Underrange*
4	*CRC error*
5	*Internal error*

Table 5 - Error codes

1.13 Accessible registers by instrument

Each M Series panel meter support different registers through the communications module. The table below shows all M Series models and the registers they support at this moment.

Instrument	*Accessible registers*	*Firmware version*
M40-P	*0, 1, 2, 6*	*21.09*
M50-P	*0, 1, 2, 6*	*50.00*
M40-T	*0, 1, 2, 6*	*24.05*
M40-A	*0, 1, 2, 6*	*22.03*
M40-D	*0, 1, 2, 6*	*23.04*
M40-R	*0*	*25.03*
M60-C1	*0, 1, 2, 6*	*27.08*
M60-CR	*0, 1, 2, 6*	*28.02*
M60-F	*0*	*26.00*

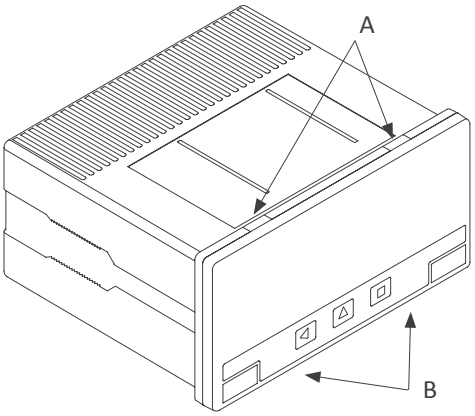
Table 4 - Relation of registers supported, per instrument

1.14 To access the instrument

You may need to access the inside of the instrument to add or replace internal modules. Use a flat screwdriver to unlock the upper clips marked with 'A'. Then unlock the lower clips marked with 'B' and remove the front cover. Let the inside of the instrument slide out of the housing.

To reinsert the instrument make sure that all modules are correctly connected to the pins on the display module. Place all the set into the housing, assuring that the modules correctly fit into the internal guiding slides of the housing. Once introduced, place again the front cover by clipping first the upper clips 'A' and then the lower clips 'B'.

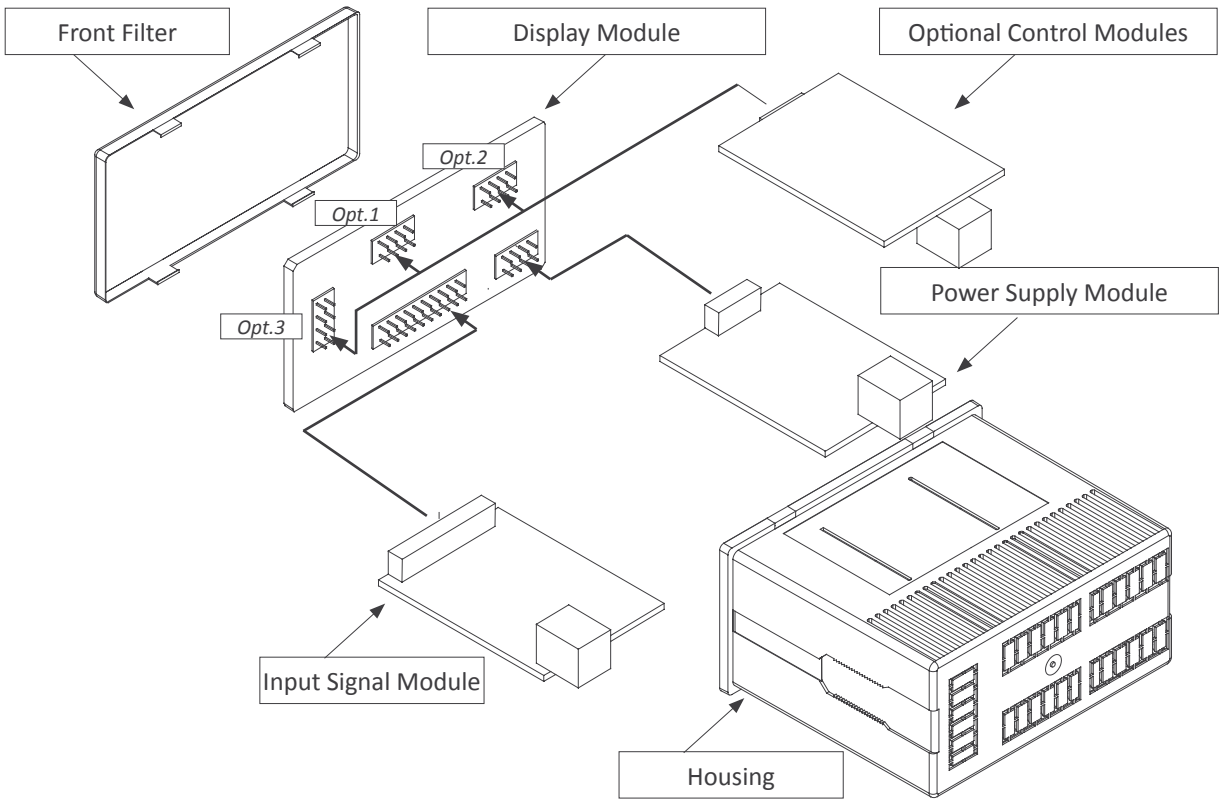
Important - If your instrument was delivered with the IP65 front seal option, accessing the inside of the instrument will permanently break the IP65 seal on the areas of clips 'A' and 'B'.



Risk of electric shock. Removing the front cover will grant access to the internal circuits. Disconnect the input signal to prevent electric shock to the operator. Operation must be performed by qualified personnel only.

1.15 Modular system

M Series panel meters are designed to create a modular system. This modular system allows for addition, replacement or substitution of any of the internal modules conforming the instrument. Below is a graphic explanation for the position of each module.



1.16 Precautions on installation

Risk of electrical shock. Instrument terminals can be connected to dangerous voltage.

Instrument protected with double isolation. No earth connection required.

Instrument conforms to CE rules and regulations.

This instrument has been designed and verified conforming to the 61010-1 CE Security Regulation, for industrial applications.

Installation of this instrument must be performed by qualified personnel only. This manual contains the appropriate information for the installation. Using the instrument in ways not specified by the manufacturer may lead to a reduction of the specified protection level. Disconnect the instrument from power before starting any maintenance and / or installation action.

1.17 Factory configuration

Configuration	
Mode	Slave
Address	1
Speed	19.2 Kbps
Format	8n1
'Master' configuration	
Destination address	31
Frequency	0.5 seconds
Tools	
Decimal point	Auto
'Legacy' mode	Off
Answer delay	0 mSeconds

1.18 CE declaration of conformity

Manufacturer FEMA ELECTRÓNICA, S.A.
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Products Module S4

The manufacturer declares that the instruments indicated comply with the directives and rules indicated below.

Directive of electromagnetic compatibility 2004/108/CEE
Directive of low voltage 73/23/CEE

Security rules 61010-1

Emission rules

61000-6-4	Generic rules of emission

Immunity rules

61000-6-2	Generic rules of immunity
61000-4-2	By contact ±4 KV - Criteria B By air ±8 KV - Criteria B
61000-4-3	Criteria A
61000-4-4	On signal lines ±1 KV - Criteria B
61000-4-6	Criteria A
61000-4-8	30 A/m a 50 Hz - Criteria A

Barberà del Vallès January 2014
Daniel Juncà - Quality Manager

1.19 Warranty

This instrument is warranted against all manufacturing defects for a period of 24 MONTHS from the shipment date. This warranty does not apply in case of misuse, accident or manipulation by non-authorized personnel. In case of malfunction get in contact with your local provider to arrange for repair. Within the warranty period and after examination by the manufacturer, the unit will be repaired or substituted when found to be defective. The scope of this warranty is limited to the repair cost of the instrument, not being the manufacturer eligible for responsibility on additional damages or costs.

Notes

Panel meters
Standard 96x48mm

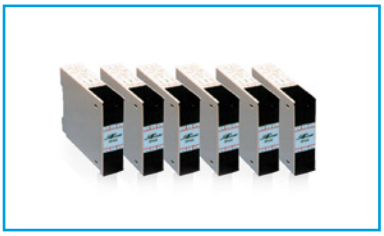
Panel meters
Miniature 48x24mm

Signal converters

Panel meters
Compact 72x36mm

Large format meters

Bar meters



Isolators

Low cost

'Customized'
instruments

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